Why Aren't More Taking Advanced

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Two decades ago, Lee Stiff and William Harvey (1988) noted that the mathematics classroom is one of the most segregated places in the United States. Despite some improvement, upper-level mathematics classes are still populated with relatively few black and Latino students. Why aren't more students from these minority groups taking high-level mathematics courses?

Contrary to persistent myth, it's not that they lack interest in math or don't have high educational aspirations. In fact, several studies document that black and Latino students sometimes have more positive attitudes toward mathematics and higher educational aspirations than do their white counterparts, especially in the early years of secondary school (Goldsmith, 2004; Strutchens & Silver, 2000). Yet students from these minority groups are less likely than Asian American and white students to complete advanced high school mathematics classes (National Center for Education Statistics, 2004; Teitelbaum, 2003), classes that are crucial prerequisites for admission to competitive colleges and for career success. Although schools have achieved greater parity for some college-preparatory courses—algebra and geometry, for example—there are still ethnicity-related gaps in enrollments in courses like trigonometry and calculus. These gaps have profound implications for students' achievement (Teitelbaum, 2003). One study found that, after controlling for demographic factors, one-third of the achievement gap in mathematics was due to course-taking differences (Secada, 1992).

Despite the curricular reforms of the 1980s, the "algebra for all" movements of the 1990s, and the advent of No Child Left Behind in the 2000s, there is still great variability in opportunities to learn higher mathematics in schools across the United States. Students attending predominantly minority schools still receive fewer opportunities to learn rigorous mathematics (Darling-Hammond, 2004; Tate, 1997).

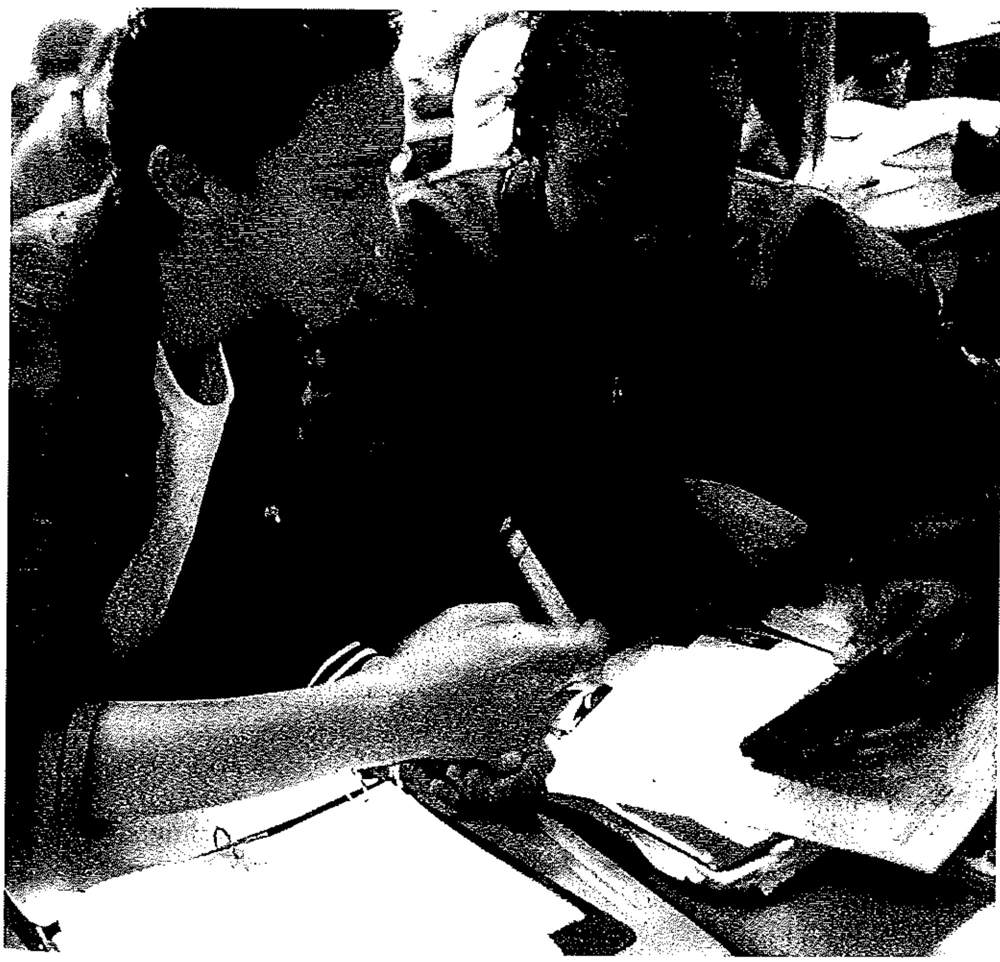
Instead of sometimes impeding student progress, how can teachers and schools support students of color in high-level mathematics? I present here six suggestions—three that focus on necessary shifts in educators' attitudes and three that focus on curricular shifts—that can help foster improved math achievement for underrepresented students.

Expand Our Thinking About Who Can Do Mathematics

Too often, ethnic minority students' opportunities are limited because of others' perceptions of their ability to do mathematics. School and teacher practices that hold minority students back from doing advanced mathematics abound (Walker, 2003). Some schools offer limited numbers of high-level mathematics courses, thus restricting the

Minorities Math?

By examining our assumptions and widening curriculum choices, we can bring more minorities into upper-level math.



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number of students who can enroll. Teachers may not recommend students for advanced classes for inappropriate reasons. For example, in a school at which students' grades were evaluated at the end of each quarter to determine which students should be moved into higher math courses, a black student who excelled in her general-level algebra course was not moved up. Her teacher justified this decision by saying she needed this student to remain in the general-level course because she was a good role model for other students in this predominantly black and Latino class.

Teachers' perceptions of their students and what those students are capable of affect the type of curriculum, instruction, and assessment teachers offer. School leaders' perceptions of what is "realistic" or "necessary" for certain students affect whether a school offers advanced mathematics courses, what textbooks the school chooses, where students are placed, and how principals assign teachers.

The increasing resegregation of U.S. schools (Orfield, Frankenberg, & Lee, 2002–2003) may also be linked to fewer opportunities for black and Latino students to do high-level mathematics. When students from these minority groups attend predominantly white schools, tracking practices may lead them to be segregated in low-level courses (Oakes, 1995). When they attend predominantly minority schools, there may be fewer advanced course offerings available within the school as a whole, and their teachers may present lower-level math curriculum, even in advanced classes (Darling-Hammond, 2004).

Build on Minority Students' Existing Academic Communities

Teachers and school administrators must think beyond pervasive assumptions that peer-group influences among underrepresented students are largely

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negative. Instead of assuming that ethnic minority students' peers and communities do not support their mathematical achievement, teachers should tap into the supportive networks that many minority students actually possess (Walker, 2006).

In a recent study, I interviewed 21 black, Latino, and Latina high math achievers at Lowell High School in New York City, which is a majority-minority, high-poverty school. I asked them, among other questions, Who or what contributes to your success in math? Their answers and anecdotes revealed that they had extensive networks of teachers, peers, parents, and siblings who supported their math achievement.

These networks, like those historically present in many minority communities, emphasized the importance of education. In many cases, students were supported by adults who had not done well in school themselves or had even dropped out but encouraged the students to study math. Although in some cases these adults did not explicitly help the students with mathematics, they urged them to do their homework and take advantage of opportunities. As a Latina student named Ana said, "My mom, she never went to school, but she loves math. She's like, you should do well, and math helps you."

Individuals in these students' academic communities discussed mathematics with them, tutored them, and urged them to persist. Several students, in turn, informally tutored friends and family members. One student noted:

> Me and my friend Andrew...we talk about math every day after class. Like when we have a test we talk about who got the higher grade, or "Why did you get that part wrong?" (Walker, 2006, p. 60)

Learn from Schools That Promote Math Excellence

The dominant discourse about underrepresented students and mathematics achievement focuses largely on deficiencies and overlooks evidence of academic excellence within these populations—as well as evidence from schools that promote high achievement among these students (for an exception, see Martin, 2000). Studies of such schools and classrooms (such as Gutierrez, 2000; Ladson-Billings, 1997) note that they are characterized by meaningful relationships between teachers and students, high expectations by teachers, and rigorous curriculums.

To create more sites of math excellence for underserved students, we should look to the success stories. Too often, schools serving large populations of minority students emphasize "slowing down" or providing less mathematics content, rather than providing more challenging content. Yet postsecondary institutions that foster success in mathematics among underserved students do not appear to steer their students toward lower-level math streams, but toward professions demanding high-level math. For example, in 2000, historically black colleges and universities served 25 percent of black students who graduated with a bachelor's degree, yet they graduated 40 percent or more of all black students who received bachelor's degrees in physics, chemistry, astronomy, environmental sciences, math, and biology. In 2004, such colleges made up 12 of the top 15 schools graduating high numbers of black students with bachelor's degrees in mathematics (Southern Education Foundation, 2005).

According to a 2005 study commissioned by the Southern Education Foundation, historically black institutions use these key elements to prepare students for careers in science, technology, engineering, and mathematics:

- Intense, personal introductory programs for new students.
- High levels of counseling, mentoring, and guidance.
- Rigorous interactive instruction.
- Adequate financial aid.
- Meaningful research experiences and internships.
- Hospitable, caring campus climates.

Several mathematics- and science-focused programs at predominantly white institutions (such as the Meyerhoff Scholars Program at the University of Maryland, Baltimore County) support the development of underserved students as mathematicians. These programs also focus on students' talents rather than supposed deficiencies. They offer a supportive group culture for mathematics, rigorous coursework, and enrichment opportunities, similar to the practices of the historically black schools.

Expand the Options in School Mathematics Courses

The unvarying nature of school mathematics in the United States—the repetition of elementary coursework and the rigid hierarchy of secondary mathematics courses—dampens interest in mathematics for many students, not just minorities. Math enjoyment decreases with the years: In 1996, 69 percent of U.S. 4th graders reported liking mathematics, whereas only

50 percent of 12th graders did so (Strutchens & Silver, 2000).

We should ensure that elementary students get the foundational skills they need while also exposing them to interesting mathematics problems linked to life experiences—problems that tap creativity, critical thinking, and problem solving. In high school, the traditional college-preparatory course sequence (Algebra I–Geometry–Algebra II–Trigonometry–Precalculus–Calculus) could also include statistics, number theory, the history of mathematics, or other rigorous topics. Such topics—and exploration of how mathematics relates to other disciplines—expand students' understanding of what mathematics is and pique their interest in pursuing it.

Many schools have experimented with block scheduling, integrated mathematics courses, courses using computer-assisted instruction, and other options. Increasing course options in summer and during the academic year clearly benefits black and Latino students. For example, Jaime Escalante's work shows that when formerly underserved students are given the opportunity to take additional math courses in summer, they can excel in AP Calculus (Escalante & Dirmann, 1990). There is no reason why students can't, for example, take Geometry and Algebra II simultaneously in preparation for more advanced coursework.

Even if high school students have problems with basic math skills, that is not an excuse for exclusively offering a low-level, rote curriculum that neither challenges students nor builds problem-solving and critical-thinking skills. Before school administrators assume that students aren't interested in advanced course options, they should inquire. In one study I conducted, underserved high school students lobbied for an AP Calculus course, much to the principal's surprise.

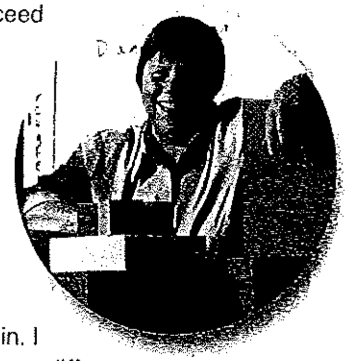
Expand Enrichment Opportunities

Many people in the United States often believe that only a few individuals can do advanced mathematics. This reflects the lack of opportunity many of us had as children to do mathematics activities outside classrooms. Young people should experience mathematics in more out-of-classroom situations. Schools can form math quiz teams, certainly, but they can also create engineering, gaming technology, or graphic arts clubs. Teachers should promote family involvement in mathematics activities, just as they promote family reading in children's early years.

We should build on existing student

My "Aha!" Moment

Judith E. Jacobs, Professor of Mathematics and Statistics, California State Polytechnic University, Pomona. Winner of the National Council of Teachers of Mathematics Lifetime Achievement Award.



"Doing mathematics is like playing chess." I remember one of my mathematics professors saying that, so I spent my time learning mathematics by memorizing the rules of the game (definitions, postulates, and theorems) and moving my pieces (mathematical statements) according to those rules. There was no room for intuition. Just learn the moves of the great chess players (mathematicians), and you would win the game (succeed at mathematics). For me, slope was $\Delta y/\Delta x$ or $(y2 - y1)/(x2 - x1)$.

It was not until my work with the Madison Project that I approached learning mathematics intuitively, looking for patterns and thinking before rushing to use symbols. I knew the patterns in a *t*-chart, the formula for finding the slope, the points on a graph, and the written equation that represents a linear function as separate entities, each requiring different approaches to discern the mathematics within. I had learned the steps for each without interrelating these different aspects of the mathematics of linear equations.

My "aha" moment was connecting these multiple ways of thinking about and representing linear equations. Mathematics was no longer isolated skills and facts. It was an interconnected discipline that I had the power to uncover myself rather than by repeating someone else's steps.

competence in mathematics by forming peer-tutoring collaboratives, which would have the added benefit of exposing teachers to the expertise of students (thus challenging the myth that teachers are the sole arbiters of mathematics knowledge) and solidifying the knowledge of student tutors.

Reduce Students' Isolation

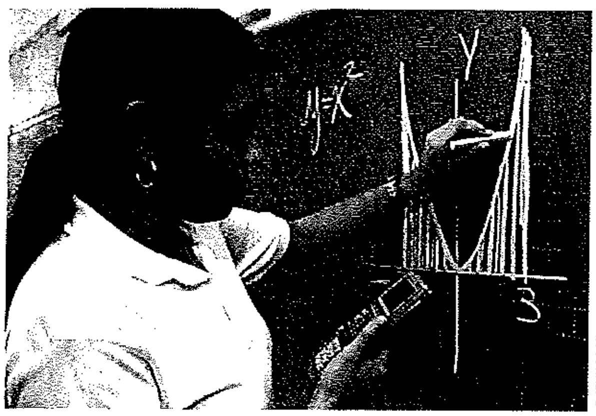
Several researchers (for example, Boaler, 2002) have explored "mathematics identity" and how school and classroom dynamics affect students' math engagement. Minority students may feel isolated in advanced math classes in predominantly white settings, and this isolation can have a negative effect on their persistence and retention (Walker & McCoy, 1997). Because 35 to 40 percent of black and Latino students attend predominantly white schools (Goldsmith, 2004), schools should organize classes so that a critical mass of underserved students can take advanced math courses together. We must ensure that black and Latino students develop a diverse peer network that supports their mathematics achievement.

The fact that mathematics is a social enterprise should not be taken lightly. Teaching and learning math is not necessarily a color-blind enterprise. Students in one study (Walker & McCoy, 1997) expressed reluctance to ask questions or speak up in front of white peers for fear of badly "representing the race":

> If you're in math class and the teacher calls on you, and you're like the only black person in there, you don't want to say something wrong 'cause she might think you representing your whole race when you say it. . . . That's what I hate about being about two or three blacks in our class, because you say something, they'll look at you like "where'd she get that from?" (Walker, 1997)

Some studies suggest that minority students avoid taking advanced mathematics courses in school because they want to take classes with their friends (Walker & McCoy, 1997). Allegiance to peers, particularly in a predominantly white setting, may trump students' academic interests.

Providing students the opportunity to study mathematics in diverse groups, demonstrate their expertise in nonthreatening settings, solve problems collaboratively, and ask questions in class without the burden of being "the only one" may sound like indulging personal issues that have nothing to do with math. But negative school and classroom experiences have powerful effects on students' achievements and aspirations (Goldsmith, 2004). Paying attention to the affective aspects of learning is important. Goldsmith's analysis of data from the 1988 National Education Longitudinal Study found that black and Latino youth studying in predominantly minority schools with predominantly minority teachers had the highest career expectations and educational aspirations of all black and Latino students polled. Minority students attending predominantly minority schools with a mostly white teaching staff had the next highest aspirations, followed by minority students in predominantly white schools. Further, on both reading and math tests, Goldsmith found that black and Latino students with a strong belief in their own potential achieved higher than did such students with low expectations.



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These suggestions do not mitigate the need to provide increased resources to schools serving large numbers of underserved students. But they provide direction for what we can do now. We are overlooking innumerable chances to develop excellence in math achievement among black and Latino students. We know that building on students' positive perceptions of mathematics while providing rich opportunities to do mathematics in and out of school can increase the numbers of minority students demonstrating such excellence. Let us commit to doing so on a large scale. EL

References

Boaler, J. (2002). The development of disciplinary relationships: Knowledge, practice, and identity in mathematics classrooms. *For the Learning of Mathematics, 22*, 42–47.

Darling-Hammond, L. (2004). The color line in American education: Race, resources, and student achievement. *DuBois Review, 1*(2), 213–246.

Escalante, J., & Dirmann, J. (1990). The Jaime Escalante mathematics program. *The Journal of Negro Education, 59*(3), 407–423.

Goldsmith, P. A. (2004, April). Schools' racial mix, students' optimism, and the Black-White and Latino-White achievement gaps. *Sociology of Education, 77*, 121–147.

Gutierrez, R. (2000). Advancing African-American urban youth in mathematics: Unpacking the success of one math department. *American Journal of Education, 109*(1), 63–111.

Ladson-Billings, G. (1997). It doesn't add up: African American students' mathematics achievement. *Journal for Research in Mathematics Education, 28*(6), 697–708.

Martin, D. B. (2000). *Mathematics success and failure among African American youth: The roles of sociohistorical context, community forces, school influence, and individual agency.* Mahwah, NJ: Erlbaum.

National Center for Education Statistics. (2004). *The condition of education.* Washington, DC: U.S. Department of Education.

Oakes, J. (1995). Two cities' tracking and within-school segregation. *Teachers College Record, 96*(4), 68–69.

Orfield, G., Frankenberg, E. D., & Lee, C. (2002–2003). The resurgence of school segregation. *Educational Leadership, 60*(4) 16–20.

Secada, W. G. (1992). Race, ethnicity, social class, language, and achievement in mathematics. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 623–660). Reston, VA: National Council of Teachers of Mathematics.

Southern Education Foundation. (2005). *Igniting potential: Historically black colleges and universities and science, technology, engineering, and mathematics.* Atlanta, GA: Author.

Stiff, L. V., & Harvey, W. B. (1988). On the education of black children in mathematics. *Journal of Black Studies, 19*(2), 190–203.

Strutchens, M. E., & Silver, E. A. (2000). NAEP findings regarding race/ethnicity: Students' performance, school experiences, and attitudes and beliefs. In E. A. Silver & P. A. Kenney (Eds.), *Results from the seventh mathematics assessment of the National Assessment of Educational Progress* (pp. 45–72). Reston, VA: National Council of Teachers of Mathematics.

Tate, W. F. (1997). Race-ethnicity, SES, gender and language proficiency trends in mathematics achievement: An update. *Journal for Research in Mathematics Education, 28*(6), 652–679.

Teitelbaum, P. (2003). The influence of high school graduation requirement policies in mathematics and science on student course-taking patterns and achievement. *Educational Evaluation and Policy Analysis, 25*(1), 31–57.

Walker, E. N. (1997). *African Americans' perceptions of their mathematics performance.* Unpublished master's thesis, Wake Forest University.

Walker, E. N. (2003). Who can do mathematics? In B. Vogeli and A. Karp (Eds.), *Activating mathematical talent* (pp. 15–27). Boston: Houghton Mifflin and National Council of Supervisors of Mathematics.

Walker, E. N. (2006). Urban high school students' academic communities and their effects on mathematics success. *American Educational Research Journal, 43*(1), 41–71.

Walker, E. N., & McCoy, L. P. (1997). Student voices: African Americans and mathematics. In J. Trentacosta and M. J. Kenney (Eds.), *Multicultural and gender equity in the mathematics classroom: The gift of diversity* (pp. 34–45). Reston, VA: National Council of Teachers of Mathematics.

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